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(54) Abstract Title  
**A digital TV receiver with means for finding alternative regional transmissions or alternative audio**

(57) An apparatus for outputting a selected digital channel, the apparatus comprising channel selecting means for selecting a digital channel to be outputted, the channel selecting means comprising logical channel selecting means for selecting the logical channel number of the required digital channel (BBC 1, BBC2) and alternative channel selecting means for selecting an alternative channel (BBC1 TxB, BBC2 TxB) having the same logical channel number as that selected by the logical channel selecting means. The selection of different audio channels is also described.

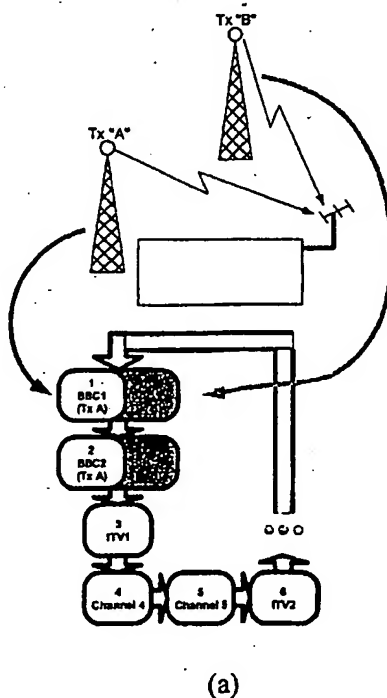


Figure 4

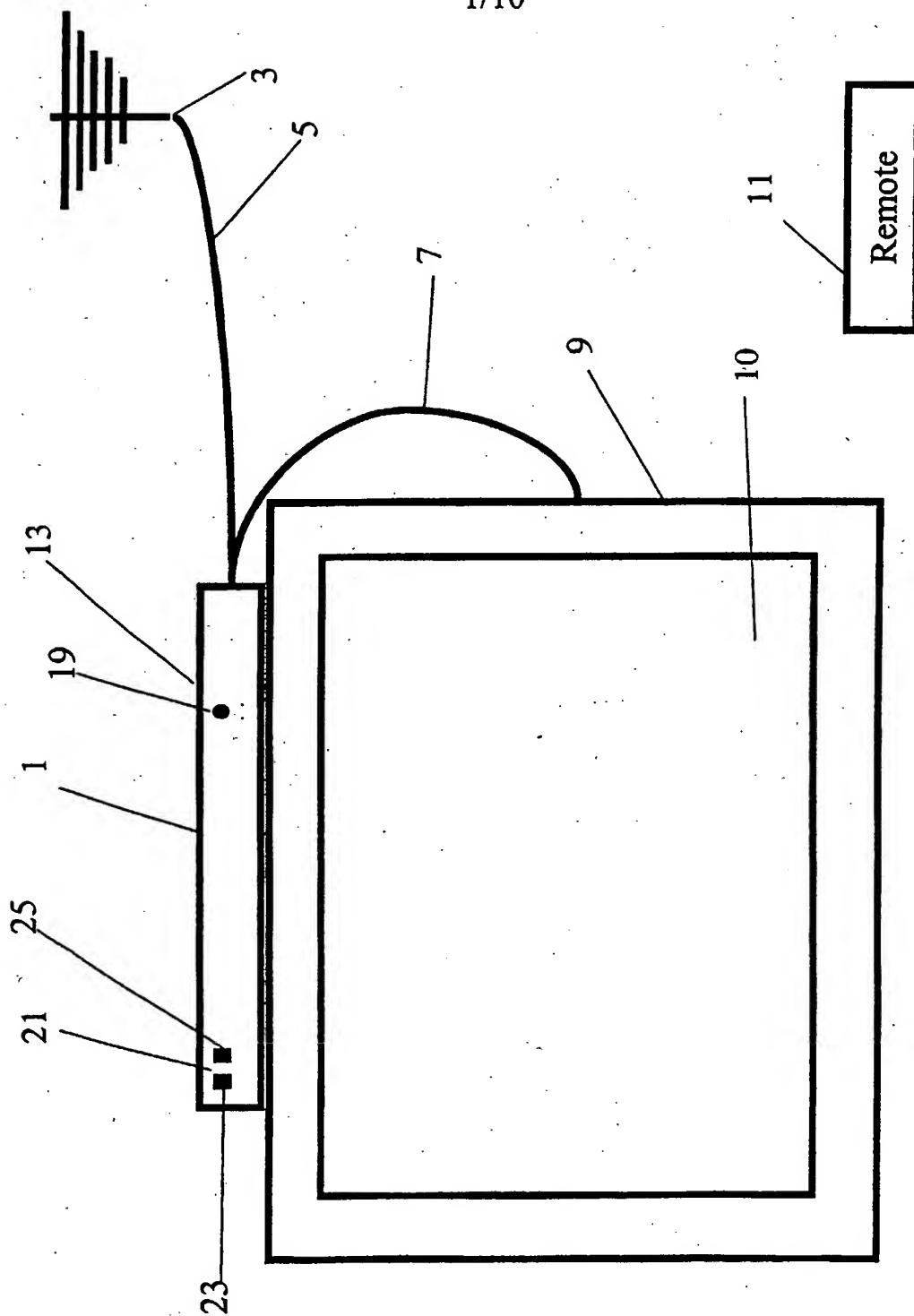


Figure 1

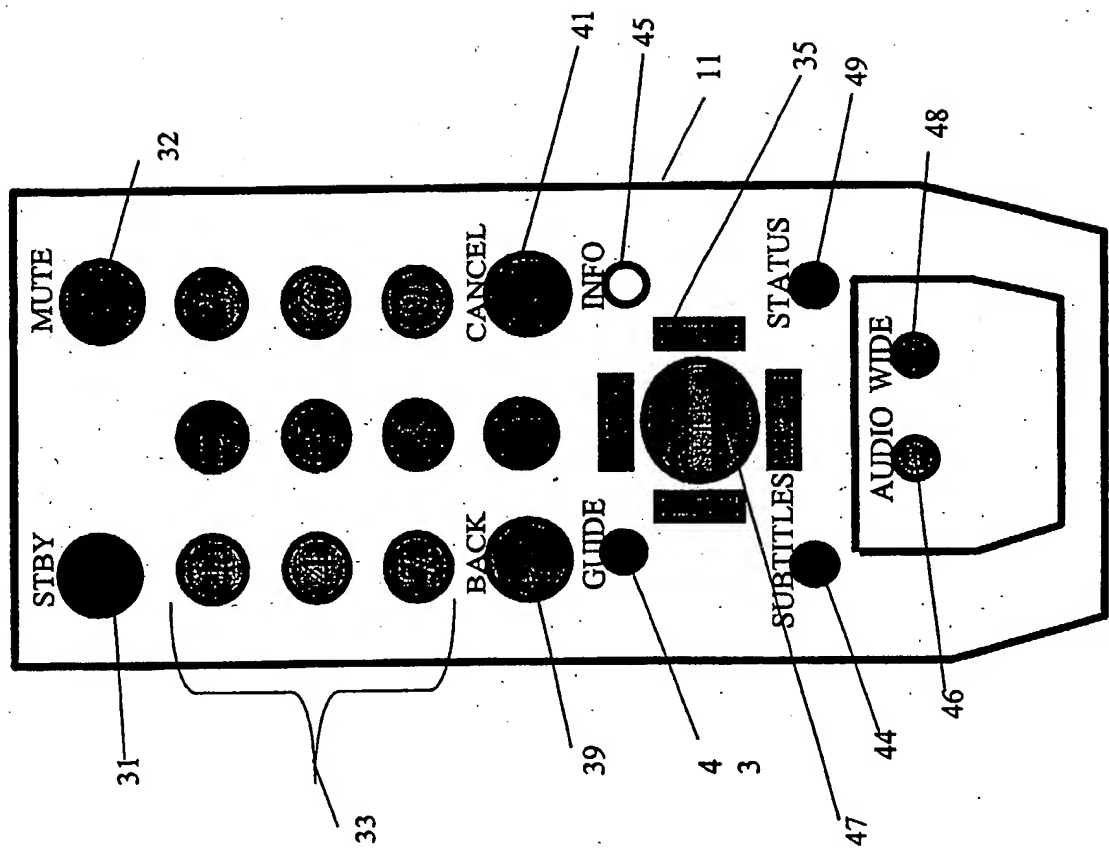


Figure 2

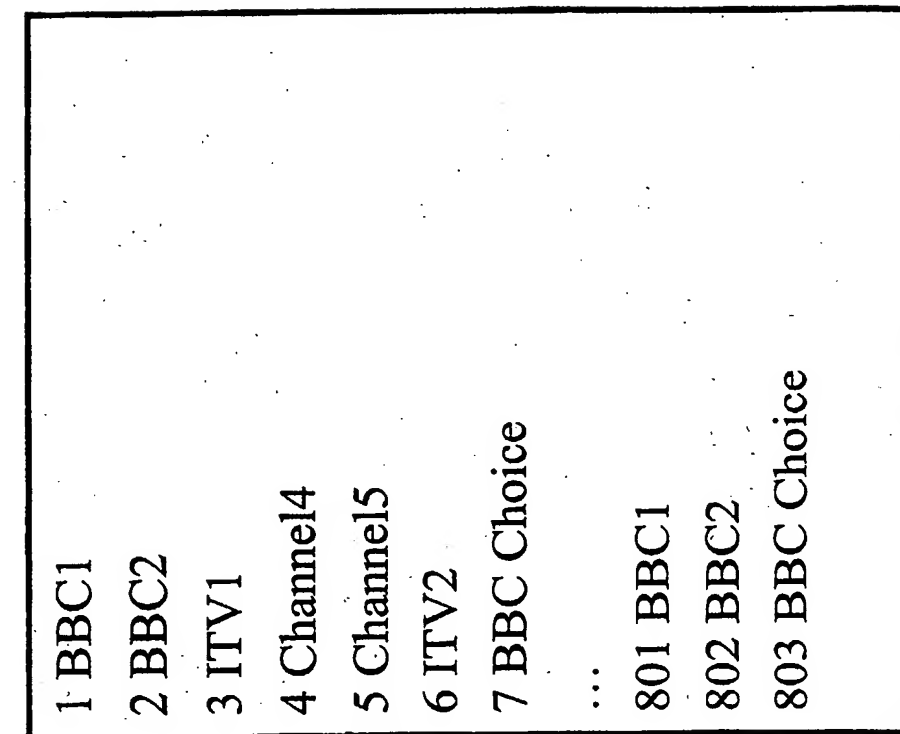
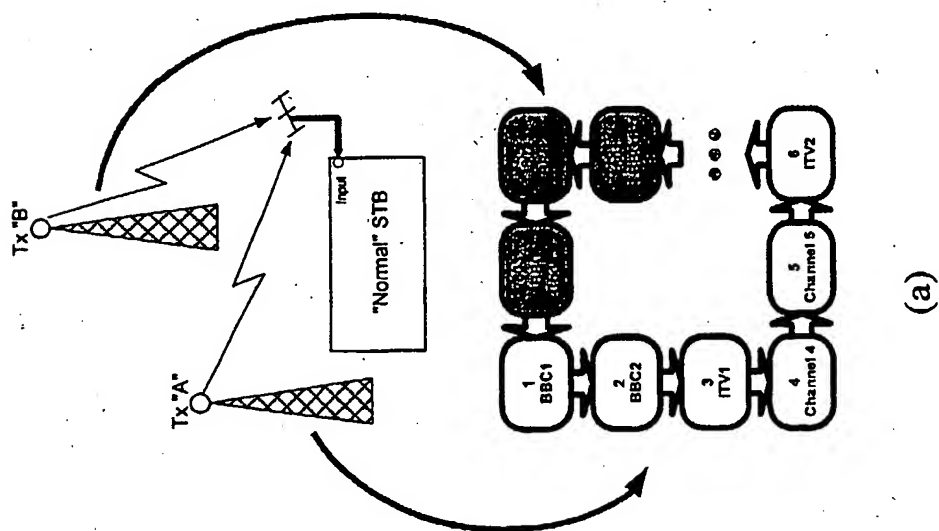


Figure 3



(b)

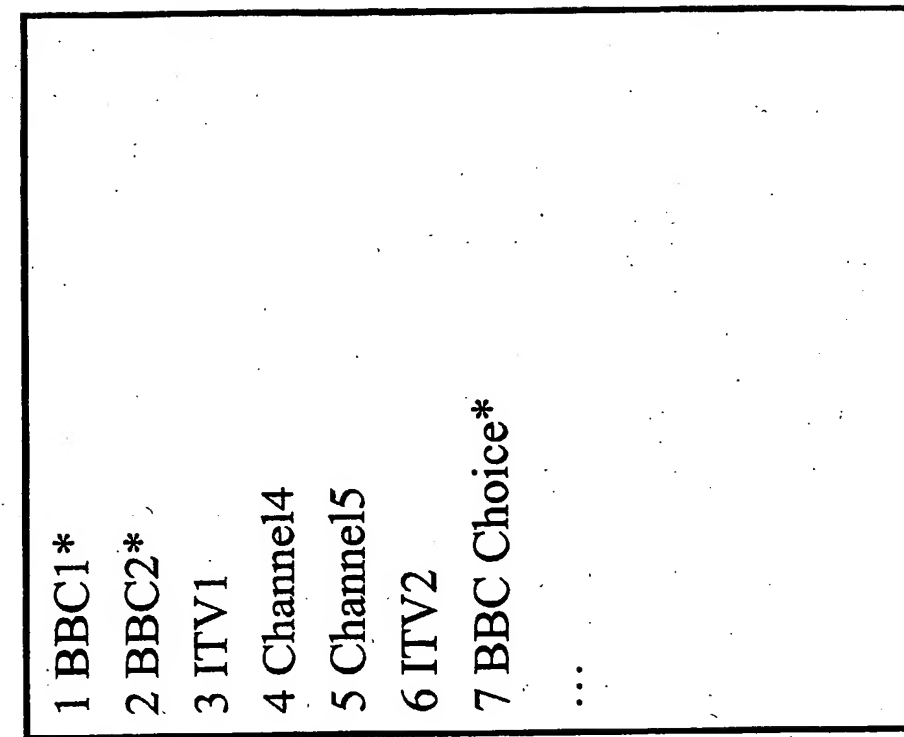
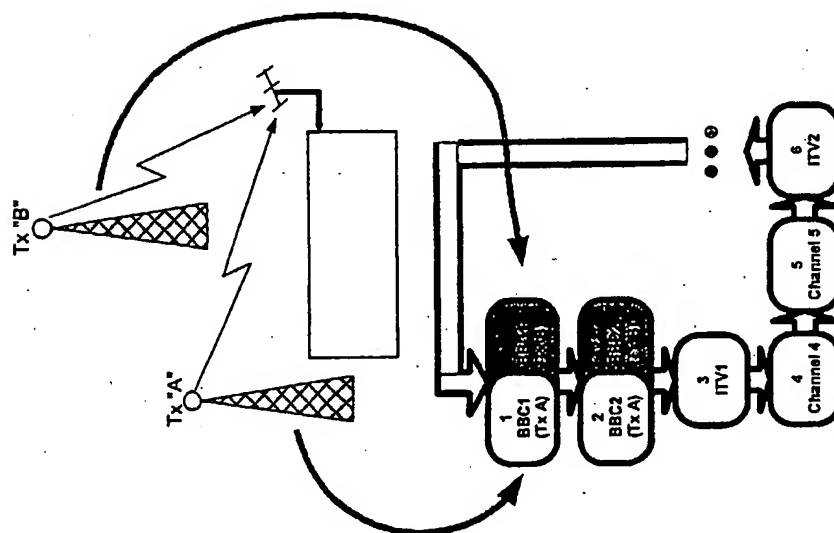


Figure 4

(b)



(a)

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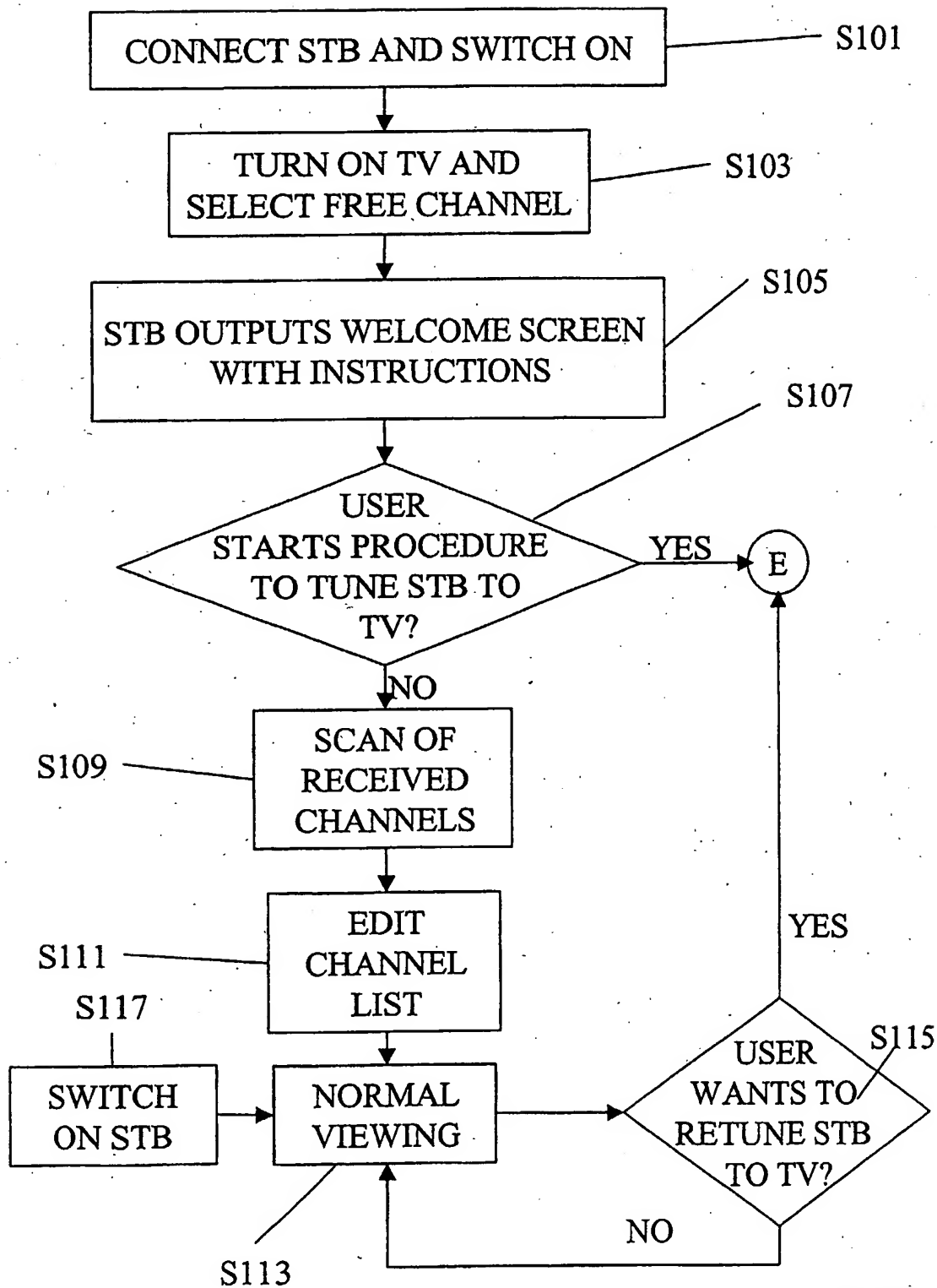


Figure 5

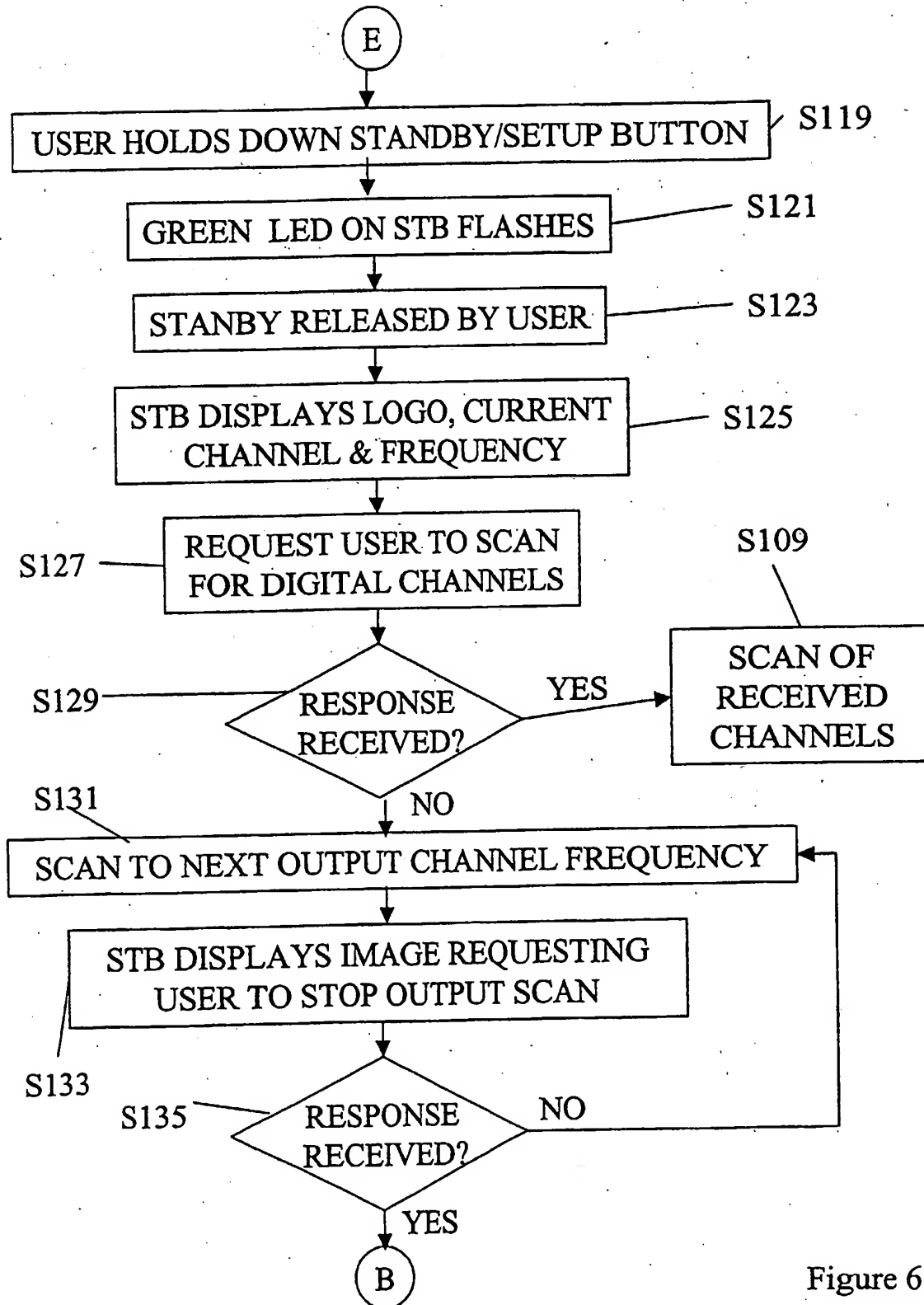


Figure 6

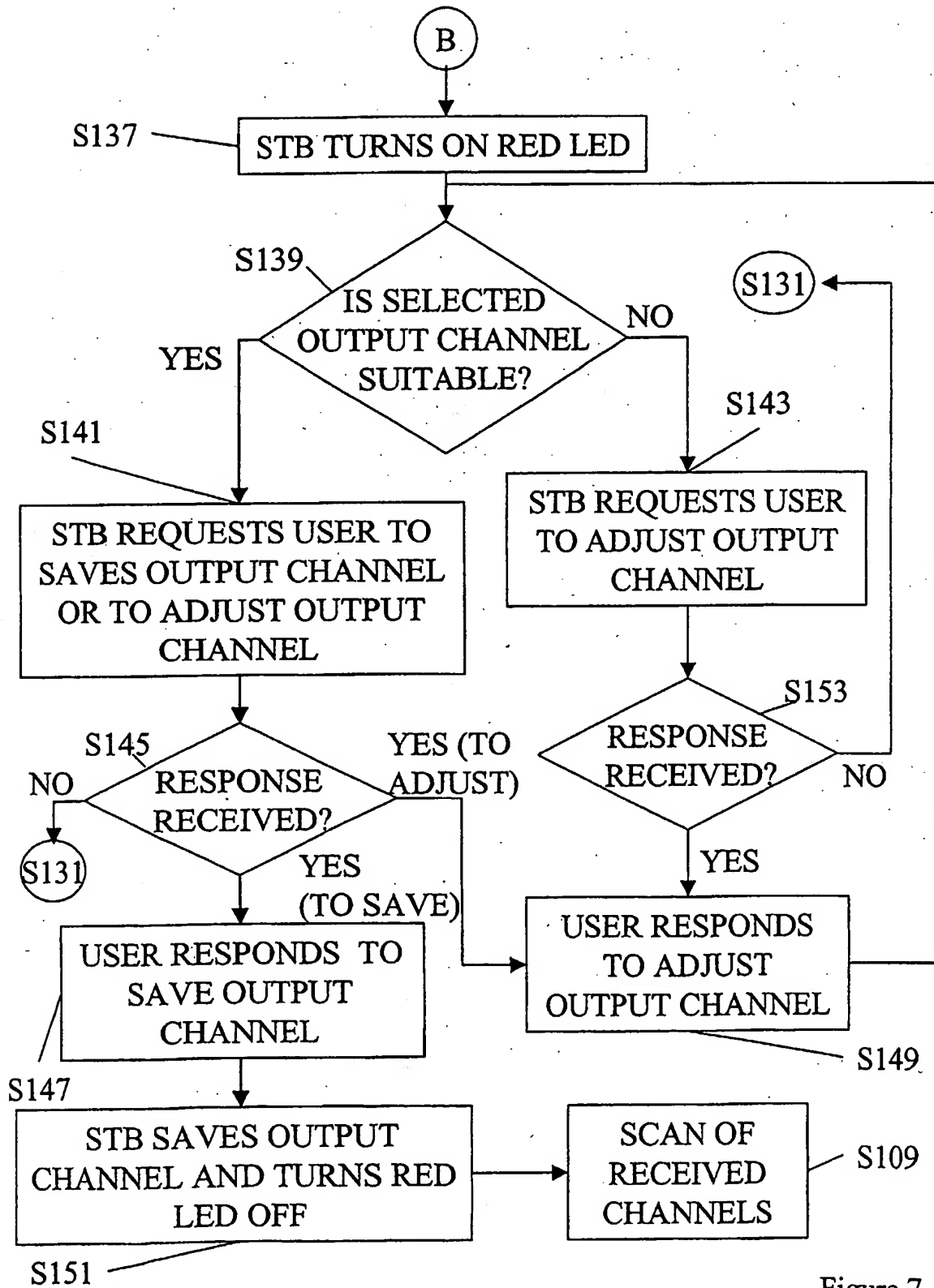


Figure 7



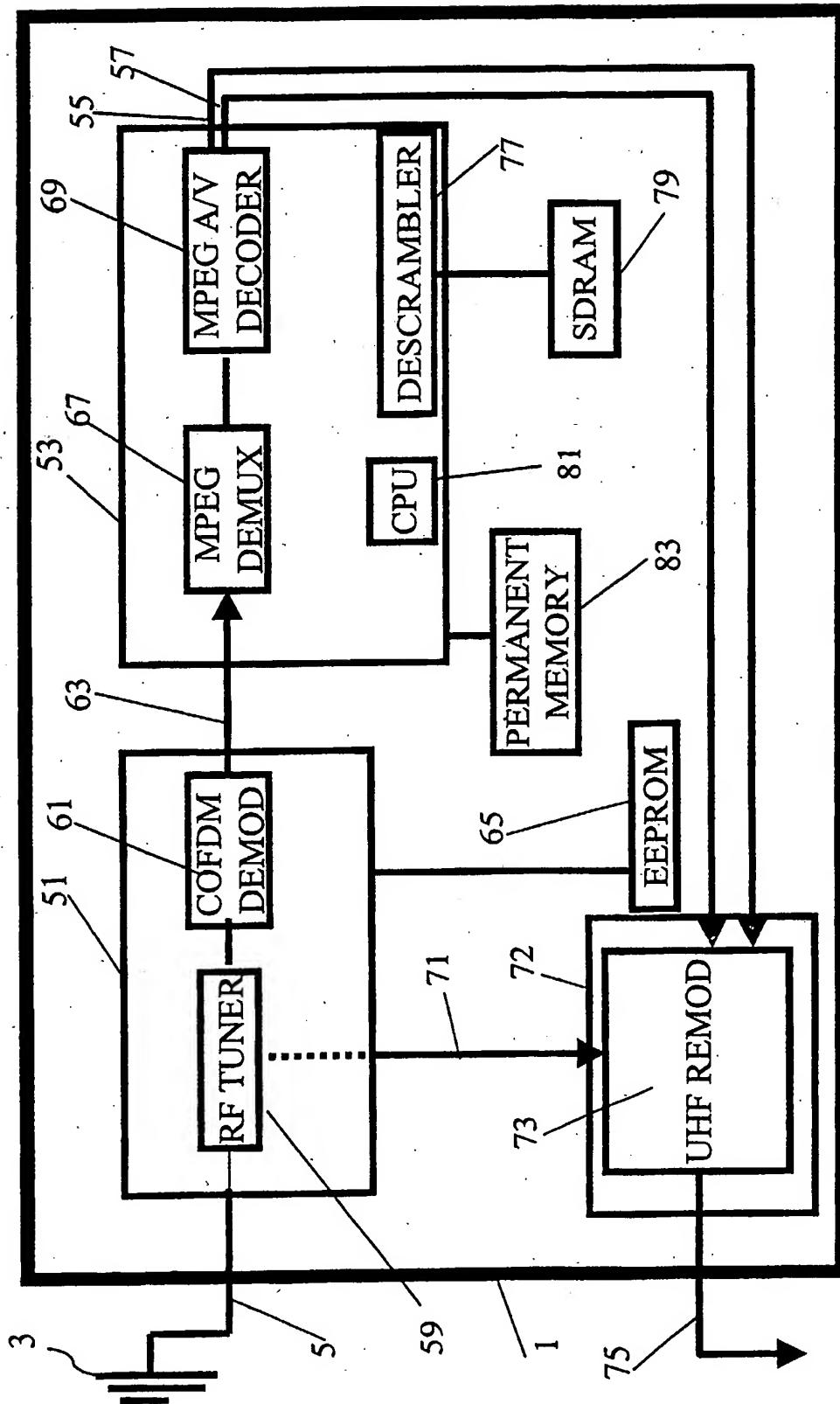


Figure 8

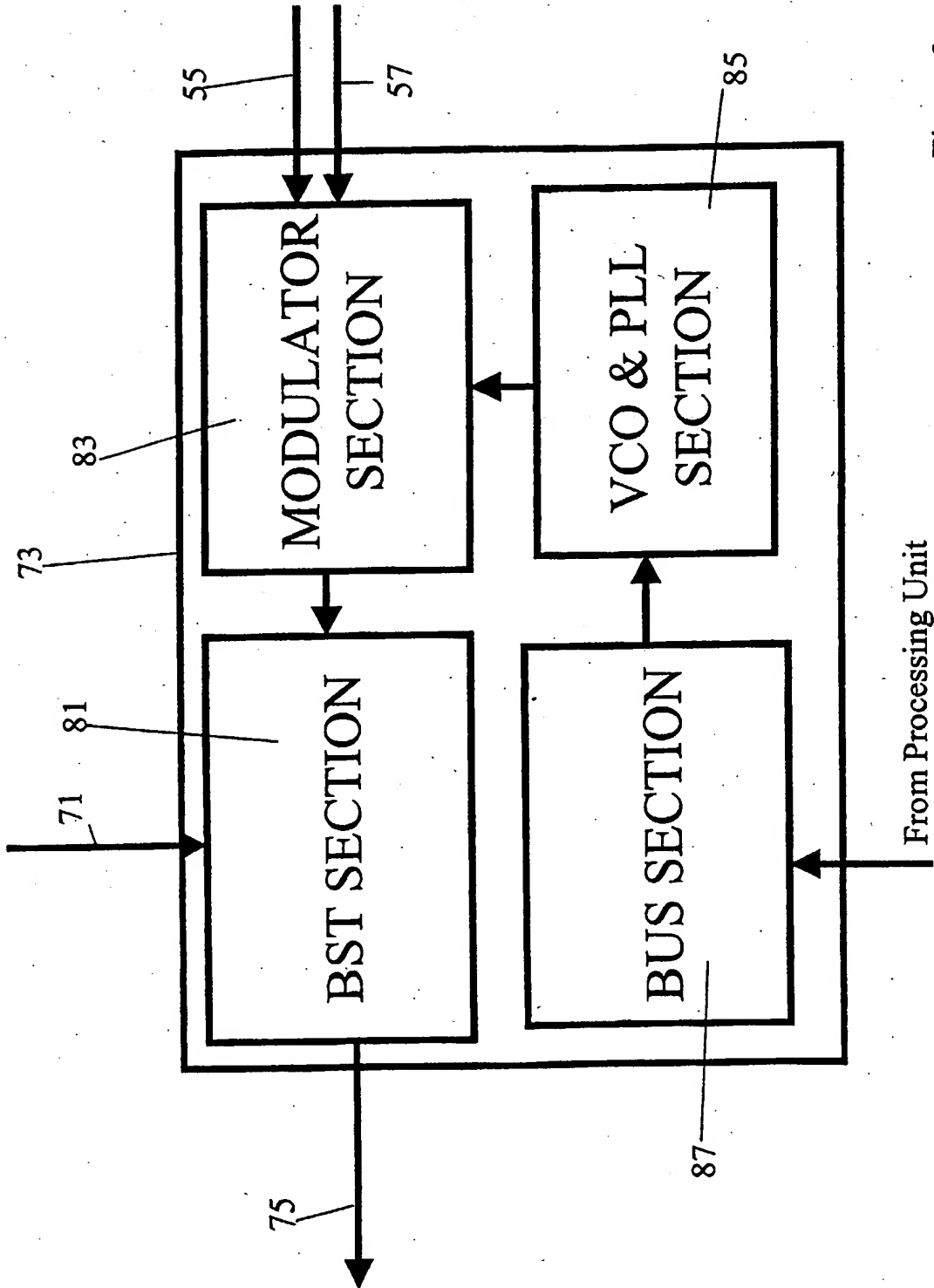


Figure 9

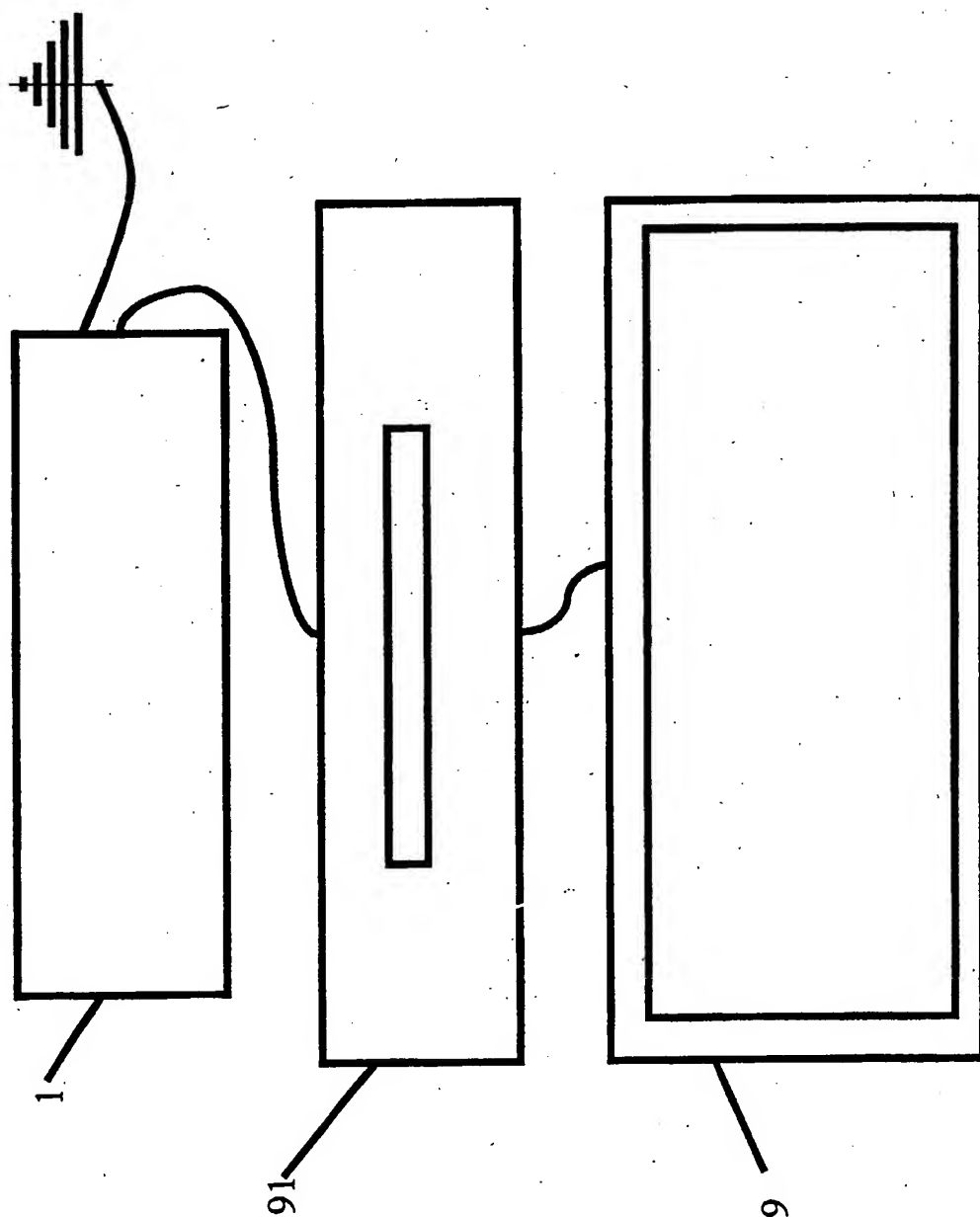


Figure 10

Apparatus for Outputting Digital Broadcasts

The present invention relates to the field of apparatus for outputting digital broadcasts. More specifically, the present invention relates to an apparatus, such as a so-called digital set-top box (STB) which outputs a desired digital channel selected by a user.

Digital broadcasting is becoming more and more popular due to the fact that it allows many more channels to be transmitted on fewer frequencies, each with higher quality television pictures and sound.

When digital channels are broadcast, they may be broadcast with information which indicates a logical channel number. For example, in the UK, BBC1's logical channel number is one, BBC2's logical channel number is two, BBC Choice's logical channel number is seven etc. To output these received channels, each channel is allocated its own output channel number. Most apparatus for outputting these digital channels, for example, digital set-top boxes, digital televisions, etc will automatically assign the logical channel number as the output channel number for a particular channel.

A digital broadcast receiving apparatus may receive digital channels from more than one transmitter. Thus, more than one channel corresponding to BBC1 will be received, each of these channels having a logical channel number of one. Conventional digital receiving apparatus address this problem by assigning the logical channel number as the output channel number for one of the received channels and much higher output channel numbers will be allocated to the other received channels with the same logical channel number. For example, in existing systems, duplicate channels are often stored from output channel 801 onwards.

Conventional receiving apparatus may be configured to allocate the strongest signal received with a particular logical channel number to the output channel of that

same number. Sometimes, allocation will be performed randomly such that the first scanned channel or the last scanned channel will be allocated to the output channel with the same logical channel number if more than one channel is detected with a particular logical channel number.

Thus, conventional set-top boxes and other receiving apparatus allocate the output channel number as the logical channel number for just one channel received with a particular logical channel number. The other duplicate channels being stored "out of sight" of the viewer.

This is not particularly desirable, as sometimes, the content of equivalent channel transmitted from adjacent transmitters will be different. For example, a television transmitter in Wales will probably transmit BBC1 Wales with logical channel number one and will carry Welsh regional news programmes and sports programmes whereas a transmitter just over the border in England will transmit its local variant of BBC1 also with logical channel number 1. Thus, a user of a conventional STB who wishes to watch BBC1 Wales may receive BBC1 Wales, but their STB may allocate an English regional version of BBC1 to output channel 1, BBC1 Wales being hidden away on channel 801 onwards.

Also, transmission from a particular transmission may be poor so it is not desirable for the user to be essentially restricted to using just one transmitter.

In this situation, the user can only see his preferred BBC1 if the user actually realises that his preferred channel has been stacked away at a high channel number.

The present invention at least partially addresses the above problem, and in a first aspect provides an apparatus for outputting a selected digital channels, the apparatus comprising channel selecting means for selecting a digital channel to be outputted, the channel selecting means comprising numerical channel selecting means for selecting the logical channel number of the required digital channel and alternative channel selecting means for selecting an alternative channel having the same logical channel number as that selected by the logical channel selecting means.

Thus, the apparatus of the present invention stacks channels having the same logical channel number on top of each other. This allows the user to then scan through these channels to select his preferred alternative channel when the appropriate logical channel number has been selected.

Preferably, the apparatus also comprises storage means for storing information identifying the viewer's preferred alternative channel such that the next time when the user enters the relevant logical channel number, his preferred channel with the entered logical channel number automatically appears.

More preferably, the storage means is a non-volatile storage means so that the user's preferred local channel is stored when the apparatus is switched off and on.

In order to indicate that alternative channels are available for a particular logical channel number, the apparatus preferably comprises display means configured to indicate that alternative channels are available. For example, if the apparatus is a digital set-top box or digital television, an asterisk or other symbol is displayed by the channel number on the channel select menu in order to indicate that more than one channel is available with this logical channel number.

Thus, in a second aspect, the present invention provides an apparatus for receiving and outputting broadcast digital channels, the apparatus comprising: receiving means for receiving broadcast digital channels and determining the logical channel number of the received digital channels; and indicator means for indicating to a user if more than one channel has been received with the same logical channel number.

The logical channel selection means may be activated via a numerical keypad where the user inputs the actual logical channel number required in a conventional manner. Alternatively, keys may be used which allow the user to sequentially page up or down through the available logical channel numbers. Typically, up and down arrow keys are provided.

The alternative selection means may also be provided by at least one key which allows the user to sequentially page through the plurality of alternative channels. Preferably, left and right arrow keys are provided to allow the user to scan through the alternative channels.

The logical channel selection means or the alternative channel selection means may be provided by a remote control which is located remote from the set-top box, digital television etc.

In addition to the above selection means, the apparatus may also comprise format selection means which allows the user to select a particular screen format for displaying the received digital broadcast. Digital television signals often use the 16:9 wide-screen format whereas analogue television signals generally use the 4:3 format. As the apparatus may be required to output signals in either of these formats, preferably, a format selection means is provided which allows the user to switch between displaying the screen using the 16:9 format or the 4:3 format.

If the display format is different to the transmitted screen format, then the picture may be stretched in either the vertical or horizontal directions. A simple key press allows the user to simply choose the best format for the picture being displayed at the moment.

The key may also be used to select an automatic mode, where the apparatus determines the preferred display format.

The present invention is primarily intended for use in apparatus which both receive as well as output digital channels. Thus, preferably such as STBs and digital televisions comprises scanning means for scanning digital broadcasts and storage means for storing information identifying the location of a received digital channel where the information is stored according to their logical channel number so that the channel is displayed by a user inputting the relevant logical channel number.

The apparatus is preferably configured to store information identifying the location of a received digital channel as either relating to a preferred channel or an alternative channel. The preferred channel being the channel which is displayed when its logical channel number is entered, the alternative channel being the channel which is accessed using the alternative channel selection means once its logical channel number has been selected.

A channel is stored as a preferred channel if the received channel either has a different logical channel number to that of the other received channels or if the received channel has the same logical channel number as that of other received channels but is designated as a preferred channel.

Generally, a designated preferred channel will be selected by the user during use of the apparatus. However, when the system is initially set up, the user will not have had time to interact with the apparatus to communicate his preferences to the apparatus. In this case, the designated preferred channel may be the first or last received channel with a particular logical channel number or may be the channel with the strongest signal out of the received channels which have the same logical channel number.

The digital channels received by the apparatus are generally digital program channels which comprise a video channel and at least one audio channel. Often, there is more than one audio channel, for example, in order to allow audio coverage in a number of different languages. Thus, preferably, the apparatus further comprises audio channel memory means for storing information identifying a preferred audio channel for each program channel such that when a program channel is selected for output, its preferred audio channel is output.

Storing specific audio channel information for each program channel is a capability which is not provided by current set top boxes which allow the user to set just one audio channel setting for all channels.

Thus, in a third aspect, the present invention provides an apparatus for selectively outputting digital program channels, each of said program channels



comprising a video channel and at least one audio channel, the apparatus comprising selecting means for selecting a specific program channel to be output and memory means for storing information identifying a preferred audio channel for each program channel such that when a program channel is selected its preferred audio channel is output.

To allow the user to store his preferences, the apparatus preferably requires means to update the designated preferred channel.

Generally, the digital receiving apparatus will be a so-called digital set-top box (STB). However, the apparatus may be provided in the form of a circuit or module to be installed directly into a television set, video recorder or other type of audio/video apparatus.

The present invention is primarily intended for use with digitally broadcast signals and more specifically, television signals but may also be used with pure audio signals.

The broadcast may be provided via wireless terrestrial networks, satellite or cable, or any of a variety of in-house wired or wireless distribution systems.

The apparatus will now be described with reference to the following non-limiting preferred embodiments in which:

Figure 1 illustrates a television with a set-top box in accordance with an embodiment of the present invention;

Figure 2 illustrates a remote control which may be used in accordance with the embodiment of Figure 1;

Figure 3a schematically illustrates a channel allocation system of a conventional STB and Figure 3b illustrates a schematic channel menu displayed by the STB;

Figure 4a schematically illustrates a channel allocation system in accordance with a preferred embodiment of the present invention and the channel menu of the STB of Figure 3a and Figure 4b schematically illustrates channel menu of the STB of Figure 4a in accordance with a preferred embodiment of the present invention; and

Figure 5 is a flow diagram of the steps performed by the STB of Figure 1 when it is switched on;

Figure 6 is a flow diagram of the processes performed to tune the STB to the TV output;

Figure 7 is a continuation of the flow diagram of Figure 6;

Figure 8 is a block diagram of the main electrical components of the set-top box of Figure 1;

Figure 9 is a block diagram of the UHF/VHF remodulator of Figure 8; and

Figure 10 is a schematic of the STB of Figure 1 connected to a TV via a video.

In Figure 1, a set-top box (STB) 1 is connected to aerial 3 via UHF cable 5. The STB 1 is connected to television 9 via UHF cable 7. UHF cable 5 is the standard aerial feed for the television 9 but is plugged into the STB 1. Output cable 7 from STB 1 is configured to be connected to the aerial feed port (not shown) on television 9. The output is a standard UHF/VHF output carrying a standard TV signal such as NTSC, SECAM, PAL or the like.

The STB 1 may additionally be connected to the TV using a SCART (peritelevision) connector (not shown) which carries an unmodulated pure video signal and audio signal.

A remote control 11 is configured to communicate with STB 1. Details of the remote control 11 will be described with reference to Figure 2.

In operation, analogue and digital television signals are received by aerial 3 and communicated to STB 1 via UHF cable 5. STB 1 decodes received digital television signals and outputs the decoded digital television signals and analogue signals to television 9 via UHF cable 7.

The STB 1 can only output one digital channel at a time. The selected digital channel is output from STB 1 as a UHF analogue television output signal along with any analogue television signals which are also received by aerial 3.

The television 9, is a conventional analogue television which has a plurality of user selectable output channels which are used to display analogue television channels, on screen 10, normally received directly from aerial 3. To display an analogue channel received from aerial 3, an output channel of the television is selected and this channel is tuned to the frequency of the desired received analogue channel.

Prior to the STB 1 being installed, the analogue television 9 received analogue television signals direct from aerial 3 and selected output channels of the television 9 were tuned to display the various analogue television channels.

With the STB 1 now connected between the aerial 3 and the television 9, the television still receives the analogue channels. However, in addition, it also receives an analogue television output signal corresponding to a selected digital channel.

The television 9 can only display this digital channel if one of the free channels of the television and the STB output signal are tuned to the same frequency.

Previously, a free channel of the television had to be tuned to the frequency of the output signal of the STB. However, as will be explained in greater detail with reference to figures 3 to 5, in the present invention, the output of the STB is tuned to that of a free channel of television 9 thus avoiding the need for the user to work out how to tune the television to the STB.

The STB outputs the decoded digital signal in the form of a standard analogue television signal which can be received and displayed by a standard analogue television set. Examples of such standard analogue television signals are NTSC, PAL or SECAM etc, each of which comprise a plurality of frequencies with a fixed relationship to each other. These plurality of frequencies can be thought of as constituting an output channel. Thus, tuning the STB can be understood either in terms of varying the output frequency of the STB or varying the output channel of the STB.

In addition to outputting the received digital and analogue television signals, the STB outputs information to the analogue TV 9 to be displayed as an on-screen display (OSD) message. Examples of OSDs are channel banners which indicate the name of the selected channel, icons which indicate a status of the STB such as muted, volume etc. OSDs may also be used to display program information.

OSD messages are used to indicate user information such as, now and next program information, channel guide, the selected channel when the user changes channel, whether the output of the STB has been muted etc. Examples of OSD messages will be described with reference to the specific functions of the STB.

The channel outputted by the STB is selected using remote control 11 (which will be described in more detail with reference to figure 2).

The channels are assigned to their logical channel numbers by the STB using data embedded in the digital signals received, e.g. BBC1 is STB channel 1, BBC2 is STB channel 2...BBC choice is STB channel 7 etc. Depressing the down channel selector on the remote control allows the user to scan through the channels in descending order.

The up channel selector and down channel selector may also be used for navigation in the program guide, information for which is received by the STB. This will be described in more detail later. Also, the up and down selectors are used in the procedure to tune the STB to the television. This will be described in more detail with reference to figures 5 to 7.

The local control interface 13 comprises standby/setup button 19 which allows the set-top box 1 to be switched from an operational mode to a standby mode.

In the standby mode, STB 1 is in a low power mode where the tuner (7) is held in a reset mode and there is no conversion of digital signals to audio and video signals (the tuner and decoding apparatus will be described with reference to figure 6). The standby mode can be accessed at any time during normal viewing by pressing standby/setup button 19. When the standby/setup button 19 is pressed briefly, the STB mutes both audio and video outputs. Other housekeeping functions are performed when the standby mode is entered such as checking for previously undetected digital channels.

The STB will also perform a scan for digital channels. This will be described in more detail after the discussion of figure 3.

The Standby/setup button 19 is also used to tune the STB 1 to the TV 9. This will be described in detail with reference to figures 3 to 5.

STB 1 also comprises display area 21 which has a red LED 23 which is lit when the set-top box is in a standby mode and a green LED 25 which is lit when the box is in an operational mode. The LEDs may be simultaneously lit or may flash etc. to indicate other modes of operation, for example during tuning of the STB 1.

Figure 2 shows an example of a remote control which may be used to control the STB of figure 1. Remote control 11 comprises standby button 31 which allows STB 1 to be switched between a standby mode and an operational mode in the same manner as described with reference to button 19 on the box. However, standby button 31 is not used in the same manner as standby/setup button 19 to tune the STB to the TV 9 which will be explained with reference to figures 3 to 5.

Mute button 32 is provided which allows the user to mute the outputted sound from the STB 1. The mute button specifically toggles on and off of both the UHF

modulator audio intercarrier and baseband audio outputs of the STB 1. When the mute button mutes the sound an appropriate icon is displayed on the screen 10 of television 9 using the OSD capability of STB 1. The mute is reset to off when the STB is switched out of standby or powered on from mains cycling.

A numerical key-pad 33 is provided which comprises 10 keys numbered from 0 to 9. Key pad 33 allows the user to input numerical values, for example, to select a particular digital channel, provide a numerical response to a prompt displayed on the screen 10 of the television 9. The STB is configured to display digits, pressed by the user, on screen 10 using its OSD. When a channel is selected, the STB 1 outputs a channel banner indicating the channel, which overlies the displayed program using the OSD facility.

The STB 1 is also configured to display interim channel banners when multiple digit channels are selected using the number keys. The STB is configured to wait for 1 second for a second numerical key to be pressed. For example, if "1" is pressed, the STB displays a channel banner on screen 10 with "BBC1", if another "1" is received within one second, the channel banner is changed to "BBC News 24" which is currently on channel number 11.

If an encrypted channel is selected, a blank screen will be shown and the STB outputs an OSD message on the blank screen indicating that the selected channel has become unavailable.

Some channels are audio only channels, e.g. BBC Parliament. When such channels are selected, the audio channel will be outputted from the STB and the TV screen 9 will be blank. The STB 1 will output an OSD message to be displayed on the blank screen indicating that the selected channel is an audio channel only.

An arrow key arrangement 35 is also provided on remote control 11. Arrow key arrangement comprises an up arrow key, a down arrow key, a right arrow key and left arrow key.

The up and down arrow keys allow the user to scan through the available digital channels in ascending order. As the STB 1 scans through the digital channels, the channel number and name is displayed as a channel banner using the OSD capability of STB 1 on the screen 10 of television 9. The up and down arrow keys are also used in the tuning processes which will be described with reference to the flow chart of figures 5 to 7.

The channel selected by the up and down arrow keys or the numerical keypad is the channel with the selected logical channel number. However, often, the STB will receive more than one channel with the same logical channel number. Sometimes, channels with the same logical channel number will be identical, e.g. the same channel will be received from two transmitters configured to transmit the same channels. However, sometimes, they will be different as the channel may have some programs which are specific to its broadcasting region, for example, news programmes and sports programmes differ from region to region.

When a user selects a particular logical channel number if only one channel received with a particular logical channel number, then that channel is displayed. However, if more than one channel is received with a particular logical channel number, then the "preferred" channel with the selected logical channel number is displayed. The STB also indicates that alternative channels are available.

Alternative channels with the selected logical channel number may be selected by depressing the left and right arrow keys. The last alternative channel selected by the user is then stored as the "preferred" channel for a particular logical channel number. Thus, the next time a user selects a logical channel number, the STB will output the channel which was previously selected with that particular logical channel number. This will be described in more detail with reference to Figures 3a to 4b.

The left and right arrow keys may also be used to navigate the program guide.

The channel management and selection process will be described in more detail with reference to figures 3 and 4.

A "Back" button 39 is provided which allows the user to toggle between the currently viewed and previously viewed channel. The previously viewed channel will not be stored when the power is cycled on the STB but will be stored when the STB enters standby mode.

As well as operating in a so-called 'normal viewing' mode, where the STB 1 outputs the received analogue and digital channels, the STB can also operate in other modes where it outputs information concerning the outputted digital channels. These modes are accessed by pressing the guide 43, info 45, select 47 or status 49 buttons.

Guide button 43 is provided, which when depressed during normal viewing mode causes the STB 1 to enter 'guide mode'. In guide mode, the STB outputs the program guide for display on screen 10 of TV 9. Specifically, the program guide is a list of program channels with the title of the current program and the next program on each program channel.

The list of program channels comprises all free to air (FTA) channels defined on the user's list of channels. How the user defines this list will be explained with reference to figure 3. Only program channels which were not 100% encrypted when the user defined the channel list will be displayed by the program guide.

If a channel is currently unavailable, for example, if the transmitted program has been scrambled by the service provider, then the program guide will indicate that the channel is currently unavailable.

An info button 45 is provided which, when depressed during normal viewing mode, causes the STB 1 to enter 'info' mode. In 'info' mode, the STB outputs as an OSD using a detailed synopsis for the program currently being transmitted on the channel being viewed when the user entered "info" mode. The display information is taken from the broadcast service information streams received by the STB 1. Broadcast service information contains information relating to delivery system, content and scheduling/timing of broadcast streams etc.



A select button 47 is provided which, when depressed during normal viewing mode causes the STB to enter 'select' mode. In 'select' mode, the STB outputs as an OSD, the title and start times of the current and next programs transmitted on the selected channel and the current time, so called 'now and next information'. The displayed information is summary version of that displayed when the info button 45 is depressed.

The now and next information disappears when the select button 47 is depressed again and the STB switches back to normal viewing mode. The now and next information also disappears if the STB receives no user input in the 40 seconds after the select button has been pressed.

The select button 47 is also used during the set-up of the STB, this will be described in more detail with reference to figure 3.

The STB enters 'status mode' when the status button 49 is depressed. In this mode, the STB outputs information concerning the current set-up of the STB (e.g. the selected wide mode, audio channel, output frequency and channel of the STB), information concerning the currently selected channel and data concerning the signals received by the STB 1.

Cancel button 41 is used to cancel guide, info, select or status modes and to return the STB to normal viewing mode.

Previously, the functions accessible by just pressing one of the function buttons have been described. However, it is possible to press a sequence of buttons.

If the channel is changed after the select mode has been entered, by either entering another channel number via the numerical keys 33 or using up and down arrows, the now and next information for the newly selected channel is displayed.

Pressing the info button 45 or the guide button 43 just after pressing the select button 47 has the same effect as if the info 45 or guide 43 buttons were pressed in normal viewing mode.

Once the info button 45 has been pressed, the STB 1 enters an info mode and outputs extended program information for the program currently transmitted on the selected channel is displayed. Pressing either the left or the right arrow keys 35 displays extended program information for the next program to be transmitted on the selected channel. Pressing either of the left or right arrow keys 35 again causes the extended program information to be displayed for the current program. Thus, the left and right arrow keys 35 can be used to toggle between extended program information for the current and next program transmitted on the selected channel.

Pressing the up or down arrow keys 35 on the remote control 11, or entering a different channel number using numerical key-pad 33 on the remote control 11 when the STB is in info mode, causes the STB to output extended now information for the channel number selected by the arrow keys or numerical key pad.

Pressing select when the STB is in info mode causes the STB 1 to switch out of info mode and display the channel whose extended information was outputted when select was pressed. Normal viewing of this channel can then continue.

Pressing guide 43 when the STB is in info mode causes the STB to switch to guide mode and output the program guide. Pressing cancel 41 causes the STB to switch back into normal viewing mode where it outputs the channel which was selected when the info mode 45 was entered.

The guide mode of the STB 1 is accessed by pressing the guide button 43. Pressing the up or down arrow keys 35 on the remote control 11, or entering a channel number using numerical key-pad 33 on the remote control when the STB is in the guide mode causes the newly selected channel number to be highlighted on the displayed channel guide.

The channel guide is likely to extend over more than one screen, other pages of the guide can be accessed by pressing the right or the left arrow keys 35 on the remote control 11.

Pressing select 47 when the STB 1 is in guide mode causes the STB 1 to enter normal viewing mode outputting the channel highlighted when select was pressed. Pressing cancel 41 when the STB 1 is in guide mode causes the STB 1 to return to normal viewing mode outputting the channel which was selected when the guide mode was entered.

Pressing the info button 45 when the STB is in the guide mode causes the STB to enter the info mode and output extended program information concerning the highlighted channel.

If no response is received from the user for 20 seconds in the guide mode, then the STB will switch back to normal viewing mode.

Entering Status mode and the pressing the Info button 45 causes the STB 1 to output more detailed status information, for example, the quality of the received signal, the current version of the software and hardware of the STB 1 and data relating to the spare capacity of the memories of the STB 1.

Pressing the guide button 43 while in the status mode causes the STB to output more detailed information, for example, relating to the size and quality of the signal received from the transmitters which are detected by the STB 1.

Subtitles button 44 when depressed toggles hides or shows subtitles which are broadcast with the digital channels.

Audio button 46 is provided which allows the user to step through the various alternative audio channels which may be provided for a particular digital program channel. For example, BBC 1 in Wales may be accompanied by both an English language audio channel and a Welsh language audio channel for certain programs. In

such an example, the audio button allows the user to switch between the two audio channels.

When a user switches between audio channels, the audio language of the newly selected audio channel is displayed as a banner on the screen 10. The selected audio channel is then saved as the preferred audio channel for the currently viewed program channel.

When a user first depresses audio button 46, the language of the audio channel is displayed as a banner on screen 10, subsequent pressing of audio button 46 steps through the particular audio channels available for the currently view program channel.

The last selected audio channel for a specific program channel is then saved as the preferred audio channel for that program channel and will be outputted the next time that program channel is selected.

A wide button 48 is provided which when pressed allows the user to scan through various screen format options. Conventional analogue signals are broadcast in full format 4:3. However, digital broadcasters tend to prefer wide screen format 16:9 as this gives a better proportioned picture. Viewing a broadcast sent using 16:9 format using a 4:3 display format causes the image to be stretched vertically. Similarly, as some broadcasts are still sent using 4:3 format, viewing these using 16:9 format results in a horizontally stretched image.

In an attempt to provide a sensibly proportioned image for both viewers using 4:3 display format and 16:9 display format, some channels and sometimes specific programs are broadcast using 14:9 format. Letter boxing is also used to correctly proportion the display area.

The STB will automatically select the display format by using the active format descriptor (AFD) transmitted with the digital channel and a look-up table within the STB 1.

If the user is not happy with the automatically selected display format, then the user can change the display format by pressing wide button 48. Pressing the wide button once causes the STB to output the display format as an OSD message.

Pressing the wide button 48 a second time allows the user to scan through the following display modes:

- Wide - 16:9 (for use with a wide screen display)

- Normal – for use with a 4:3 display. This allows the viewer to view widescreen material in the transmitted format

- Centre Cut – Out – For use with 4:3 displays (allows the viewer to view only the centre of widescreen material).

The STB is configured to store the last selected display mode and use this as the default, the next time the STB is activated.

Figure 3a schematically illustrates channel management of a conventional set top box (STB). In this example, the STB 101 receives digital signals from both transmitter A 103 and transmitter B 105. The STB needs to allocate each of the received channels a user selectable output channel number. The STB determines the logical channel number of the received digital channels and allocates an output channel number such that a viewer can select a particular channel by entering its output channel number. The logical channel number for a particular channel is transmitted with the channel data.

The STB 101 allocates the channels received from transmitter A 103 to output channels having the received channels' logical channel numbers such that BBC1 is located at output channel 1, BBC2 at output channel 2, ITV1 at output channel 3, Channel 4 at output channel 4, Channel 5 at output channel 5, ITV2 at output channel 6, etc. In addition to the channels received from transmitter A 103, the STB 101 also receives channels from transmitter B 105. It cannot allocate BBC1 received from transmitter B 105 to output channel 1 as this has already been allocated to BBC1 received from transmitter A 103. The STB 101 when it receives such a duplicate

channel allocates the second received BBC1 to, for example, output channel 801. BBC2 from transmitter B 105 to output channel 802, the next received channel from transmitter B 105 which in this case is BBC Choice to output channel 803 etc.

A typical channel menu screen produced by STB 101 is illustrated by Figure 3b. Here, the channels received from transmitter 103 are seen to be allocated to output channels having the logical channel numbers of the received channels. The channels received from transmitter B 105 are allocated from output channel number 801 onwards. Typically, the channels will not be illustrated on the menu screen expected by the user, and the user will only be able to locate such channels by accident.

Figure 4a illustrates channel management of STB 111 in accordance with an embodiment of the present invention. In the same manner as Figure 3a, STB 111 receives channels from transmitter A 103 and transmitter B 105.

In the same manner as described with reference to Figure 3a, STB 111 allocates the channels received from transmitter A 103 to output channels with the same number as the logical channel number as the received channels. However, it allocates channels received from transmitter B 105 also to output channels having the same number as the logical channel number of the received channels. Thus, there are two BBC1s, both allocated to output channel 1.

When the user first switches on the STB and selects output channel 1, BBC1 received from transmitter A 103 will be displayed. However, the user can select BBC1 received from transmitter B 105 by pressing a button which allows the user to page through alternative channels having the same logical channel number. In this particular example, these buttons are provided by the left and right arrow keys of arrow key arrangement 35 of the remote control 11 (Figure 2).

When STB 111 receives more than one channel with the same logical channel number, the STB is configured to output the preferred channel with that logical channel number when the relevant output channel is selected. On set up of the apparatus, the preferred channels may be those received with the strongest signal. However, the

apparatus is configured to allocate the user's last selected channel with a particular logical channel number as the preferred channel for that logical channel number.

For example, if the user selects output channel 1 and sees BBC1 received from transmitter A, he may prefer BBC1 received from transmitter B. The viewer accesses BBC1 received from transmitter B by pressing the right arrow key on remote control 11. STB 111 then stores BBC1 received from transmitter B as the preferred channel for output channel 1. Therefore, the next time the user selects output channel 1, BBC1 from transmitter B will be automatically displayed.

Figure 4B schematically illustrates a channel menu for the STB 111. As two BBC1s are received, the menu is displayed with an asterisk by BBC1. This indicates to the user that more than one BBC1 channel has been received by STB 111 and hence the user may page through the received BBC1 channels by using right and left arrow keys as shown with reference to Figure 2.

Next, the process of installing and tuning the STB to the television will be described with reference to figures 5 to 7.

In step S101, the user connects the STB 1 (STB) to the television 9 and aerial 3. Specifically, lead 5 (Figure 1) is a standard television aerial output from aerial 3. Instead of plugging this aerial output 5 into the back of television 9, the output is plugged into the input of STB 1. A UHF lead 7 then runs from an output of STB 1 and plugs into the standard aerial port of television 9.

Once connected, the television is turned on in step S103 and a free channel is selected. When the STB is turned on, it is in a 'set-up' mode and it outputs a welcome screen with instructions to the viewer in S105. In this set-up mode, the STB 1 may need to complete two tasks: i) scan the incoming signals to identify digital channels; and ii) tune the output signal to that of the television.

When the STB is connected to the TV and switched on for the first time, the STB will need to be tuned to the TV. However, this process will not be necessary every

time the STB is switched on. Thus, in S105, STB 1 outputs instructions to the viewer to tune the STB to the TV if required.

In this specific example, the viewer is requested to hold down the standby/setup button 19 (on the STB) to tune the STB to the TV or to press and release the Standby/setup button 19 (on the STB) if there is no need to tune the STB to the TV. If the STB is connected to the TV via a scart lead, the welcome screen is displayed on the television when the STB and television are switched on. If the STB is connected to the television via a UHF lead, then no welcome screen will be seen until the STB is tuned to the TV. In this situation, the user refers to the manual which will carry the same instructions as the welcome screen.

If the user wishes to tune the STB to the TV in step S107, the STB follows the processes which will be described later with reference to figures 6 and 7.

If the user does not wish to perform this tuning function or if the user has completed this tuning procedure, the STB proceeds to step S109 where it scans the received digital channels and stores information identifying the location of these channels.

Once the incoming digital channels have been stored and scanned, the user defines their channel list in step S111. In this step, the STB outputs a list of the currently detected FTA channels. The user, by using the up and down arrow keys 33 on the remote control, can highlight a particular channel and indicate by pressing keys indicated by the STB whether they want the highlighted channel to appear in the user defined channel list which is displayed when the previously described guide mode is entered.

The viewer exits editing the channel list by pressing select and then the STB switches to normal viewing mode. This completes the set-up procedure.

The procedure for tuning the STB 1 to the television is entered when the user holds down the standby/setup button 19 on the STB 1 for five seconds in step S119 of



Figure 6 in response to S107 of Figure 5. At this point, green LED 21 flashes on STB 1 in step S121.

Once the green LED flashes, the STB outputs a further screen indicating the current STB output channel and frequency in step S125 and requesting the user to start to scan for digital channels in step S127.

If the user sees this message, they will press the standby/setup button 19 on the STB to scan for digital channels and start the process at S109 of figure 5. If no response is received within 10 seconds, then the STB starts to scan its output frequencies/channel corresponding to its digit to tune to the TV 9. The STB output frequency is quantised into predefined number channels and the STB steps its output frequency, or more correctly output frequencies through these channels one at a time.

The STB steps to the next output channel in step S131 and outputs an OSD instructing the user to stop the scan in step S133. In this specific example, the user stops the scan by pressing the standby/setup button 19 on the STB or the select button 47 on the remote control 11. If no response is received within one second in step S135, then the STB steps its output frequency to the next output channel in step S131 and this loop is repeated until the user sees the image requesting the user to stop the scan and the user stops the scan.

The user stops the scan of the output frequency by pressing standby/setup button 19 or the select button 47, the STB turns on red LED in step S137 in response to this act of Figure 7. The STB then checks to see if the selected output channel is suitable in step S139. For example, if the selected output channel frequency corresponds to that of a digital channel received by the STB, then the output channel is unsuitable as it will suffer from poor picture quality and/or interference.

If the current output channel is not suitable, then the STB will output a request to the user in step S143 to adjust the output channel by either pressing the up arrow or the down arrow key 35 on the remote control 11 to adjust the output channel up or down

by one. If no response is received in step S153, the red LED is turned off and STB 1 returns to step S131 and starts scanning the output frequency again.

If the user responds by adjusting the output channel in step S149 using the arrow keys 35, the STB 1 reverts back to step S139 to check if the new output channel is acceptable.

If the STB determines that the selected output channel is acceptable, the process proceeds to step S141 where the STB outputs a message requesting the user to confirm that the output channel is acceptable by pressing standby/setup button 19 or select button 47, or to press the up or down arrow keys to adjust the output channel. The user may wish to adjust the output channel if the user is not entirely happy with the picture quality.

If no response is received at step S145 within 10 seconds, then the STB switches off the red led and returns to step 131 to resume scanning of its output frequency. If the user responds by adjusting the output channel in step S149, the STB reverts back to step S139 to check if the newly selected output channel is acceptable.

If the user confirms the choice of output channel by pressing standby/setup 19 or select 47, the STB 1 saves the output channel information and turns off the red LED, the scan of incoming digital channels in step S109 of figure 5 is then commenced and the remainder of the steps of the flow chart of figure 5 are completed.

If the output frequency is scanned through its whole range and no welcome screen appears or if bad interference is encountered, (for example, from a VCR or other analogue channels received by the STB 1), the selected free TV channel may not be appropriate. In this situation, the viewer can select another free channel on the TV and tune the STB to this channel.

Although the STB can scan through its preferred output channels, the user may also manually step the frequency of the output of the STB by pressing the up or down buttons 35 on the remote control 11.

The STB is configured to place a previously rejected output channel frequency at the bottom of its list of preferred output channels so that there is little chance of picking this output frequency again.

The STB will indicate to the user that it has stepped through all of its output channels using its green and/or red LED.

The above description has concentrated on the initial set up of the system. However, some of the above functions are performed again after set up.

When the standby button is pressed in normal viewing mode, the STB 1 enters standby mode and performs a scan of the received digital channels. If new channels are detected, the STB outputs an OSD message the next time the STB is removed from standby to inform the user of the new channels and requests the user to re-scan to add these channels. If existing channels are no longer detected, then they are not removed from the channel list.

When the STB 1 performs this scanning routine, the standby mode can be exited by pressing either standby/setup button 19 on the STB 1 or standby button 31 on the remote control 11. This causes the scanning of incoming channels to stop and to output the previously selected channel.

When the STB exits standby mode, it first checks to see if the initial set-up (described with reference to figures 5 to 7) has been completed. If it has not be completed, then it enters the set-up mode automatically. If set-up has been completed, the STB 1 retrieves the last watched channel from the memory and displays it. If the last watched channel is unavailable, for example if it has become scrambled, the STB will either output an OSD warning that this channel is not available or it will tune to the first available channel.

Figure 8 schematically illustrates the main components of the STB 1 of figure 1.

The STB 1 comprises three main sections:

signal receiving section 51 which receives and demodulates signals received from aerial 3;

digital signal processing section 53 which receives a demodulated digital signal from the signal receiving section 51 and processes it via audio and video baseband signal outputs 55 and 57; and

signal output section 72 which receives the audio and video baseband signals 55 and 57 and converts them into a signal which can be received by a standard analogue television, this section also received analogue signals from the signal receiving section for output with the converted digital signal.

Aerial 3 collects both analogue and digital broadcasts and sends them via cable 5 to signal receiving section 51. Signal receiving section 51 comprises RF tuner 59, which receives the signal from aerial 3. The receiving section 51, further comprises COFDM demodulator chip 61 which receives signals from RF tuner 59.

Digital television signals are broadcast using coded orthogonal frequency division multiplexing (COFDM). The digital data is sent using either 1,705 carriers or 6,817 carriers. To carry the digital data, each carrier is modulated using QPSK (where each carrier is a 2 bit carrier), 16-QAM (where each carrier is a 4 bit carrier) or 64-QAM (where each carrier is a 6 bit carrier). Analogue signals are transmitted using one of the standard analogue transmissions protocols such as NTSC, PAL or SECAM. COFDM demodulator 61 demodulates the COFDM signal.

Before the digital signal is broadcast, it is compressed using MPEG-2. The COFDM demodulator 61 outputs an MPEG-2 encoded signal. This is outputted into MPEG transport stream 63. The MPEG-2 signal is then processed in digital signal output section 53.

In this section, the MPEG signal is first demultiplexed using MPEG demultiplexer 67. The output from the MPEG demultiplexer 67 is then fed into MPEG decoder 69 which outputs audio signal 55 and video signal 57. Audio signal 55 and video signal 57 are baseband signals (Composite video with blanking and sync – CVBS

and component red, green and blue - RGB for video and simple analogue for audio) which can be displayed by an analogue television set equipped with a suitable input socket (e.g. a peritelevision or "scart" socket).

In addition to the MPEG demultiplexer 67 and the MPEG decoder 69, the digital signal output section may further comprise a descrambler 77 which allows decoding of scrambled MPEG signals. Even free-to-view digital signals are often scrambled to prevent them from being received in non-authorised countries or even in certain regions of the broadcasting country. This is necessary because of restrictions placed on the allowed territorial extent of broadcasts due to copyright and associated legal rights.

To control the STB, a processing unit 81 is provided in digital signal output section 53. The processing unit will also control certain operations performed by the receiving unit 51. Processor 81 executes the STB application which is stored in permanent memory unit 83. Permanent memory unit 83 may be a flash type memory or be provided by a simple ROM type memory. Processor 81, MPEG demultiplexer 67 and the MPEG decoder 69 use a synchronous DRAM (SDRAM) memory 79 for data storage in the execution of their tasks. This memory may also be used to store the STB application for execution (following transfer of this from the flash or ROM memory), to gain speed and flexibility advantages over execution from flash or ROM memories. The STB application primarily serves to allow user interaction with the STB and to ensure that the STB behaves in a predictable and reliable fashion.

Specifically, this program controls the following:

1. It initiates the first service once the power is switched on;
2. It performs a channel changing operation instructed by the user via either remote control 11 or local control interface 13;
3. It supports the sending of messages for displaying on the television screen 10 (figure 1) for user interaction;
4. It provides partial service information, for example, digital data described in the delivery system content and schedule/timing of broadcast datastreams; and

5. It monitors the propagation of errors and sends warnings to the viewer when errors are noted.

In addition to the permanent memory 83, the system also comprises a non-volatile programmable memory 65 which will typically be an EEPROM.

The non-volatile programmable memory 65 is used to store information which needs to be maintained when the power supply is switched off, but which will need to be frequently changed over time, or which is specific to the particular user installation. This stores the following:

1. The previously viewed digital channel, selected by the viewer using either remote control 11 or local control interface 13;
2. The previously selected widescreen mode, selected using button 48 on the remote control 11;
3. The previously selected frequency of the output signal;
4. The channel allocation map, storing the results of the last digital channel scan performed by RF tuner 59; and
5. Factory set information such as output levels etc.
6. Flags to indicate the state of the STB during production and user installation, such as "tested OK", "never installed", "fully installed and working", etc.

Audio signal 55 and video signal 57 are together fed into the signal output section 72 which comprises UHF Remodulator 73. UHF remodulator 73 forms them in to a single frequency analogue Television output signal in the VHF or UHF frequency spectrum. The UHF Remodulator 73 also comprises means for varying the frequencies of the output signal to allow the STB to be tuned to the television.

If a SCART output is additionally provided, the audio signal 55 and video signal 57 are also sent to the SCART output.

In addition to the digital signals as described above, the RF tuner 59 may also receive analogue signals. Thus, in this example, the RF tuner has a second output 71 which feeds into the UHF remodulator 73. UHF remodulator 73 modulates the baseband audio and video signals 55,57 and mixes this signal with the tuner output 71, then outputs this mixture via television output 75. The UHF remodulator 73 is described in more detail with reference to figure 9.

Figure 9 schematically illustrates the main components of remodulator 73. The remodulator comprises four main sections: a BST section 81; a modulator section 83; a VCO and PLL section 85; and a BUS section 87.

The video and audio baseband signals 55 and 57 are received by the modulator section 83. The modulator section converts the video 55 and audio signals into PAL style signals. The frequency, or more correctly frequencies, of the PAL output signal of the modulator section are modulated by the output from the VCO and PLL section 85 which operates under the control of signals received from BUS section 87.

The BUS section 87 receives commands from the processing unit 81 located in the digital signal processing section. Thus, when the STB receives instructions from the user to scan the output frequency of the digital output, the CPU sends the appropriate instructions via BUS section 87 to VCO and PLL section 85 which physically controls the output frequencies of the PAL signal from the modulator section 83.

The BST section 81 receives the PAL signal from the modulator section 83 and analogue signals direct from tuner 59 in the signal receiving section 51 to form a loop-through. The analogue signals and the PAL signal from modulator section 83 are mixed together in the BST section and outputted as TV output signal 74.

The previous description described the STB 1 being directed to television 9. However, the STB may also be connected to the television 9 via video recorder 91 as illustrated in figure 10. In such a system, the STB must be connected upstream of the video 91.

During set-up, the video recorder must be turned on (not on standby) to ensure that the selected output frequency of the STB is not interfered with by the video recorder output frequency. The frequency of the output signal from the STB may then be tuned to the video recorder as opposed to a television.

As with standard digital set-top boxes, it is not possible to record a different digital channel to the one being viewed on the television screen since the STB only outputs one digital channel at a time.

Also, while recording a digital channel, the VCR will record any information displayed on the television screen or presented to the audio channels. To overcome this problem, the set-top box may output to a VCR via a scart connector which may provide a clean AV feed.

The above specific example relates to a set-top box which detects digital signals sent over a terrestrial wireless transmission system. However, it will be appreciated by those skilled in the art that the present invention could also be adapted to receive digital signals transmitted via satellites, cable or other wired or wireless mediums. The structure of the set-top box for these uses remains similar to that described with reference to Figure 8. However, the signal receiving unit 51 would be replaced with a signal receiving unit suitable for receiving satellite, cable or other digital signals.



**CLAIMS:**

1. An apparatus for receiving and outputting broadcast digital channels, the apparatus comprising: receiving means for receiving broadcast digital channels and determining the logical channel number of the received digital channels; and indicator means for indicating to a user if more than one channel has been received with the same logical channel number.
2. An apparatus according to claim 1, wherein the indicator means comprises means for indicating if more than one channel has been received with the same logical channel number for each logical channel number.
3. An apparatus according to either of claims 1 or 2, further comprising numerical channel selecting means to select a logical channel number for a channel to be output and memory means configured to store a preferred channel for each logical channel number such that the preferred channel is output first when its logical channel number is selected.
4. An apparatus according to claim 3, further comprising alternative channel selecting means which allows a user to select between channels having the same logical channel number.
5. An apparatus for outputting a selected digital channels, the apparatus comprising channel selecting means for selecting a digital channel to be outputted, the channel selecting means comprising numerical channel selecting means for selecting the logical channel number of the required digital channel and alternative channel selecting means for selecting an alternative channel having the same logical channel number as that selected by the logical channel selecting means.
6. An apparatus according to claim 5, further comprising indicator means for indicating that alternative channels are available for a particular logical channel number.

7. An apparatus according to claim 6, further comprising memory means for storing information identifying a preferred alternative channel such that this preferred channel is outputted first when its logical channel number is next selected.
8. An apparatus according to either of claims 4 or 7, wherein the last channel selected by the alternative channel selecting means is stored as the preferred channel for its logical channel number.
9. An apparatus according to any of claims 4 or 7 or 8, wherein the storage means is a non-volatile storage means.
10. An apparatus according to any of claims 4 to 9, wherein the alternative channel selecting means is configured to allow a user to scan through channels having the same logical channel number.
11. An apparatus according to claim 10, wherein the alternative selection means is provided by at least one key which allows a user to sequentially page through a plurality of channels having the same logical channel number.
12. An apparatus according to any of claims 3 to 11, wherein the numerical channel selection means is provided by a numerical keypad.
13. An apparatus according to any of claims 3 to 11, wherein the numerical channel selection means is also provided by at least one key which allows a user to sequentially page through the available logical channel numbers.
14. An apparatus according to any of claims 3 to 13, wherein the channel selection means are activated by a control remote from the part of the apparatus which outputs the selected channel.
15. An apparatus according to any preceding claim, further comprising format selecting means to select a particular screen format.

16. An apparatus according to claim 15, wherein the format selecting means is activated by at least one toggle key which allows the user to toggle through the available screen formats.
17. An apparatus according to any preceding claim, wherein the apparatus comprises scanning means for scanning for broadcast digital channels and storage means for storing information identifying the location of the received digital channels according to their logical channel number.
18. An apparatus according to claim 17, wherein the apparatus is configured to store information identifying the location of received digital channels as either relating to a preferred channel or an alternative channel.
19. An apparatus according to claim 18, wherein information identifying a received digital channel is stored as relating to a preferred channel if the received channel has a different logical channel number to that of other received channels or if the received channel has the same logical channel number as that of other received channels and the received channel is a designated preferred channel.
20. An apparatus according to claim 19, wherein information identifying a received digital channel is stored as relating to an alternative channel if the received channel has the same logical channel number as that of other received channels and the received channel is not a designated preferred channel.
21. An apparatus according to either of claims 19 or 20, further comprising means to update a designated preferred channel.
22. An apparatus according to any preceding claim, wherein the digital channels are digital program channels, each comprising a video channel and at least one audio channel, the apparatus further comprising audio channel memory means for storing information identifying a preferred audio channel for each program channel such that when a program channel is selected for output, its preferred audio channel is output.

23. An apparatus for selectively outputting digital program channels, each of said program channels comprising a video channel and at least one audio channel. the apparatus comprising selecting means for selecting a specific program channel to be output and memory means for storing information identifying a preferred audio channel for each program channel such that when a program channel is selected its preferred audio channel is output.

24. An apparatus according to either of claims 22 or 23, further comprising audio channel selecting means configured to allow a user to change the outputted audio channel when the corresponding program channel is being outputted.

25. An apparatus according to claim 24, wherein the audio channel selecting means is configured to allow the user to scan through the available audio channels.

26. An apparatus according to claim 25, wherein the last channel selected by the audio channel selecting means is stored as the preferred audio channel for its program channel.

27. An apparatus according to any of claims 22 to 26, further comprising indicator means configured to output information indicating an audio channel selected by the audio channel selecting means.

28. A method of receiving and outputting broadcast digital channels, the method comprising:

receiving broadcast digital channels;

determining the logical channel number of the received channels; and

outputting an indication if more than one channel with the same logical channel number is received.

29. An apparatus as substantially hereinbefore described with reference to any of the accompanying drawings.

30. A method as substantially hereinbefore described with reference to any of the accompanying drawings.



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## Patents Act 1977 Search Report under Section 17

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Category	Identity of document and relevant passage	Relevant to claims
A	EP 1017233 A1 (YUEN et al)	1,5,28
A	WO 9627982 A1 (KWOH et al)	"

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.